Rent-Seeking or Wealth-Creating: What to Choose?

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Summary

This thesis presents a quite extensive literature review on literature concerning entrepreneurship, allocation of talent and rent-seeking. There is also a presentation of two models, one model concerning the allocation of talent and rent seeking. The second, demonstrates how rent-seeking affects investments in an economy.

In the empirical part of the thesis there is a re-estimation of the results found in Murphy, Shleifer and Vishny, The Allocation of Talent: Implications for Growth (1991). The result found in this study is only partially recreated here; most of the re-estimations fail to show significance at conventional levels.

Preface

In the process of writing this thesis, I have gained a deeper understanding of economics as a field and also gained enormous respect for the men and women that conduct economic research. In the process of writing this thesis I also feel that I have gained an understanding of how "vesle Jensemann" in the song "Julepresangen" by Alf Prøysen must have felt. In this song there is a young boy who wants to make a Christmas present for his mother at woodwork. He starts out with big plans for what he wants to do, things that are way too complicated for him. He therefore has to adjust his expectations of what he is able to make for his mother, and ends up making a bread board.

I feel the story of writing my master thesis has some parallels to this song, when I started writing I wanted to do everything. I wanted to make a perfect economic model of the world and then test it empirically. As I have come to learn – and I should have known – this is quite close to impossible for a Masters student. Like Jensemann I had to adjust my expectations for what I was able to produce. But in the end I think the result has turned out okay, and this is to a great extent do to my two supervisors Tone Ognedal and Fredrik Willumsen. I'm very pleased with how you two have guided me through the work with this thesis, a big thanks to both of you. I also want to thank Asmund Rygh, Carl Henrk Knutsen and Peter A. F. Brown for good discussions and helpful comments.

Last but not least, I want to thank my family and my girlfriend Katerina for supporting me and creating a good work environment at home.

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1 Introduction

According to standard microeconomic theory; all agents in an economy want to maximise their own utility – this also applies to an agent that act as an entrepreneur. Like all other economic activities, entrepreneurial activity creates both private and public rents. It is argued that the public rent is much higher than the private, especially when it comes to wealth creating entrepreneurship, Nordhaus (2004) has calculated that as little as 2.2 per cent of the total surplus form innovations is captured by the inventor.

For individuals, there are two ways to obtain wealth, they could try to increase total wealth, or they can try to obtain a larger share of total wealth. Entrepreneurship and innovation are needed for both types, but only activities that increase total wealth is preferable from the point of view of the society.[1] These two different strategies for becoming rich can be denoted redistributive[2] and productive wealth-seeking. Entrepreneurs can act as purely rent-seeking entrepreneurs, when they do so they find hiccups and inconsistencies in the economic system, and use these inconsistencies to enhance their own situation.

In this thesis I seek to answer the question; how do rent-seeking and wealth creating entrepreneurship affect the economy. I offer both theoretical and empirical answers to this question in section 4 and 5 respectively.

There are numerous examples of novel rent-seeking, I will argue that finding new ways of conducting rent-seeking is a type of entrepreneurship.[3]

[1] This is not entirely true redistributive wealth-seeking can enhance one nation above another, for example when England granted patent to John Kemp a Flemish weaver in 1331 (North and Thomas, 1973, 147).

[2] This has been a common way of acquiring wealth throughout history for mankind; "One famous example is Jericho, where already before 9000 bc there was a village on the site of a never-failing spring. A thousand years later it had grown in size until its mud-brick houses covered eight or nine acres and had big walls round them. The inhabitants clearly felt they had something to protect and possible enemies to protect it from. They owned wealth, and human beings had already discovered that one quick way to acquire it was to take it from those who had it already." (Roberts, 1993, 26).

[3] This idea was first developed by Murphy et al. (1991) and Baumol (1990, 2010).

Specifically, I will discuss two ways this can have an effect on economic growth. It can affect the economy through allocation of talent (Murphy et al., 1991), and it can have an effect through lowering the investment rate (Acemoglu, 1995). The common factor for all the above-mentioned studies is that it's the institutions in the economy that determines the amount of rent-seeking. In both models it is the compensation contract that's the source of the misallocation of talent, talent flows into the sector which offer the most attractive compensation contract.

Anecdotal evidence indicates that talented people gravitate toward sectors with high compensations to talent. For example, as Roubini and Mihm (2010, p. 191) notes: "[A]mong Harvard seniors surveyed in 2007, a whopping 58 percent of men joining the workforce where bound for jobs in finances or consulting. In a curious paradox, the United States now has too many financial engineers and not enough mechanical or computer engineers ... the last time the United States saw comparable growth in the financial sector was in the years leading up to ... 1929."[4]

Murphy et al. (1991) have tried to identify the compensation contract by using the percentage of students enrolled in undergraduate law- and engineering degrees. They have tested this idea in conjunction with economic growth; and find a statistically significant relationship in some of their regressions. I have tried to recreate these estimations with updated data, I have not succeeded in reproducing their results.

The rest of the thesis is organised as follows; section 2 introduces a classification and discussion of different types of entrepreneur. Section 3 gives a literature review of entrepreneurship in economic literature and rent-seeking, section 4 presents the theories and models of rent-seeking entrepreneurs. Section 5 tries to empirically test the relationship between rent-seeking entrepreneurs and economic growth, section 6 concludes the theses.

[4]For Princeton University graduates the number was 45 per cent Frank (2011, p. 162).

2 Entrepreneurs

First we need a definition of an entrepreneur; translated literally, "entrepreneur means one who undertakes – one of life's doers" the Economist (2006). The definition I will use is; "[A]ny entity, new or existing, that provide a new product or service or that develops and uses new methods to produce or develop existing goods and services at lower cost." (Baumol et al., 2007, p. 3). According to Kizner (2011), entrepreneurs are often seen as someone who operates when the economy is in disequilibria, but it's not clear if it's the entrepreneur who creates the disequilibrium or if the entrepreneurs guides the economy back to equilibrium. Kizner (1979) theory of the entrepreneur suggests that the entrepreneur recognise that there is a profitable arbitrage opportunity in any disequilibrium and by taking advantage of this situation helps bring the economy back to equilibrium. Schumpeter's (1981/1934) insight is that the entrepreneur's occupation is to search for profitable opportunities to upset any equilibrium, which is what innovation is in its broadest sense.[5]

In this thesis I will operate with two types of entrepreneurs, the wealth

[5] An often cited list of acts that are seen as entrepreneurial is Schumpeter (1981/1934, p. 66):

1. The introduction of a new good – that is one with which consumers are not familiar – or of a new quality of good.
2. The introduction of a new method of production, that is one not yet tested by experienced in the branch of manufacturing concerned.
3. The opening of a new market, that is, it a market into which the particular branch government during all the country in question has not previously entered, whether or not this market has existed before.
4. The conquest of a new source of supply of raw material or half-manufactured goods, again irrespective of whether the source already exist or whether it has first to be created.
5. The carrying out of the new organisation in the industry, like the creation of a monopoly position (for example through trustification) or the breaking up of a monopoly position.

creating and the rent-seeking entrepreneur. The wealth creating entrepreneurs can be split into two subcategories, the innovating entrepreneur and the replicative entrepreneur. The replicative entrepreneur is someone who organises a new business firm of any variety, whether or not a number of similar firms already exist. This is the most common type of entrepreneur. The other type of wealth creating entrepreneur – the innovative entrepreneur – has the job of discovering new ideas and to put them into action. For the innovative entrepreneurs today's practice is never good enough they are always on the lookout for a more efficient way to conduct their business. According to (Baumol, 2010, p. 18) "it is only the innovative entrepreneur who can be associated firmly with the revolutionary growth of the economy". It becomes a question of definition, if the only thing that the replicative entrepreneur does is to make identical copies of already existing firms. Then the statement is probably true. But if creating local adjustments to the new business is under the domain of the replicative entrepreneur, the statement can't be true.[6]

The easiest way to distinguish between innovating and the replicative entrepreneur is to think of the former as the agent that shifts the production possibility frontier upward, while the latter pushes the economy upward toward the current frontier.[7] This deviation lends itself nicely to economic models, if one thinks of the endogenous growth model, where the replicative

[6]Gerschenkron (1962) uses Germany's attempt to catch up with Britain – the country with the most advanced technology at the time – in the 19th century as an example to illustrate the problem of just copying other countries production units. He argues that the technology Britain exported wasn't fit for Germany since Britain's technology was more mature than what was appropriate for the German society of that time. So for coping with this Germany had to develop new institutional instrument for overcoming these obstacles. If one sees this kind of catch-ups as something done by the replicative entrepreneur, Baumol's statement can't be true. These kinds of catch-ups are also associated with revolutionary growth of the economy. Acemoglu et al. (2006) have constructed a growth model where a country's "distance to the frontier" determines the selection of suitable growth strategies.

[7]This way of thinking of the two types of entrepreneurs is credited to Professor Magnus Henrekson at the Stockholm School of Economics (Baumol, 2010, p. 199, note 9).

entrepreneur is the economic agent that is responsible for the problem that it is impossible to earn money in equilibrium, if not the inventor (innovative entrepreneur) is granted a temporary monopoly through the patent system.

The second main type of entrepreneur that I operate with in this thesis is the rent-seeking entrepreneur. I define the rent-seeking entrepreneur as someone that discovers a hitherto unknown technique of conducting rent-seeking and puts this technique in to action. Since there isn't any requirement that the new way of conducting business should add to the society's productivity, there is a possibility that a new business model is developed to capture rents instead of creating them. This leads to the possibility of rent-seeking entrepreneurs; obviously all types of entrepreneurs are somewhere between being completely rent-seeking or rent-creating entrepreneurs. Someone who comes quite close to being a pure rent-seeking entrepreneur is the entrepreneurs from Somalia. These entrepreneurs has discovered and pioneered new methods for pirateering.

The phenomenon of rent-seeking entrepreneurs ranges from discovering ways to capture society's institutions with an unknown method e.g., new methods for tax evasion, new financial instruments or outright bribing government officials. Most rent-seeking entrepreneurs are not criminals; a big part of what constitutes the group rent-seeking entrepreneurs operates within the boundaries of the law. Historically this group has often been constituted by people from professions like; bureaucrats, military personnel and the clergy. These professions are seen as occupations that offers opportunity for rent-seeking entrepreneurs (Baumol, 1990; Murphy et al., 1991; Fukuyama, 2011, esp. chapter 23). Factors favouring rent-seeking entrepreneurs and wealth creating entrepreneurs can be found in table 1.

The case of rent-seeking entrepreneurs can be seen as originating from how political or economic institutions are structured, or as a result of culture and individual moral. Since entrepreneurs are an integral part of economic growth, the determinants of whether or not an entrepreneur conducts

Table 1: Factors favouring rent-seeking entrepreneurs and wealth creating entrepreneurs

	Factors making rent-seeking an attractive choice	Factors making entrepreneurship an attractive choice
Market size	Large resources go to "official" rent-seeking sectors, such as the government, army, or religion. Poorly defined property rights make wealth accessible to "unofficial" rent-seekers. Large wealth is up for grabs, especially relative to smaller goods markets.	Large market for goods. Good communication and transportation that facilitate trade.
Firm size	Substantial authority and discretion of rent-seekers (such as government officials, army, etc.) enable them to collect large sums unhindered by law or custom.	Easy entry and expansion, few diminishing returns in operations, access to capital markets.
Contracts	Ability to keep a large portion of collected rents. In firms, observability of output that yields appropriate rewards.	Clear property rights, patent protection. No expropriation of rents by rent-seekers. Ability to start firms to collect quasi-rents on talent.

Source: Murphy et al. (1991)

rent-seeking or wealth creating entrepreneurship is determined by the same fundamental causes as economic growth. Acemoglu (2009, chapter 4) gives four candidates for these fundamental causes, these four are: luck, geography, culture and institutions. Acemoglu and Robinson (2012, p. 39) uses the difference between the two entrepreneurs Carlos Slim and Bill Gates to

illustrate how different institutions give different entrepreneurs.[8] Mr Slim became rich through political contacts, while Mr Gates become wealthy by starting and developing one of the world's biggest software companies.

As noted by Baumol (2010), the entrepreneur has never found his proper place in economic theory. There are several reasons for this; the most important is probably that most economic models are concerned with economies that are in equilibrium. So when the entrepreneur is mentioned, economists from the classical era are regularly brought up in the discussion. But it isn't the superstars of classical economics – like Smith and Ricardo – that are mentioned, it is Cantillon (1755) that first introduced the entrepreneur. And later Say (1841, 1852) provided the first comprehensive discussion of the entrepreneur in economic analysis, emphasising the effect of the entrepreneur's reputation, judgement, and risk bearing on profit. Frank Knight's (1921) Ph.D. dissertation Risk, Uncertainty and Profit addresses the supply and demand of entrepreneurship in the economy. There exist some attempts at bridging the gap between mainstream microeconomic theory and entrepreneurship in the literature. Most notably among this works are Baumol (2010), who attempts to bring the entrepreneurs and innovation into the theory of value. As he writes: "My belief ... is that I provide here the first quasi-formal, theoretical analysis of the role and activities of the *innovative* entrepreneur – an entrée into the elementary theory of value."[9]

[8] At the time of writing this two are number one and two on Forbes list of the most wealthy individuals in the World.

[9] Italics in original.

3 Literature Review

There are some works that linked the allocation of talent with rent-seeking and entrepreneurs, most notable among these works are Baumol (1990), Murphy et al. (1991) and Acemoglu (1995). The work by Baumol has a non-technical character and makes use of historical case studies that underpins his argument. Baumol's argument is that the amount of entrepreneurs in the society can be seen as constant, but what kind of activity they should choose to deploy their talent in is determined by the compensation contracts. This is also the main point in the work by Murphy et al. (1991) and Acemoglu (1995), but these works are underpinned by a mathematical model. I will have a more thoroughgoing presentation of these works below.

Works that are not directly related to the allocation of talent but has interesting implications and are further developed by other authors such as Mohtadi and Roe (2003), is the endogenous growth literature that started with Romer (1990)[10] and further developed by for example Aghion and Howit (1992, 1998, 2009). Aghion and Howit emphasised creative destruction as an important part of economic growth.[11] Creative destruction is a result of wealth creating entrepreneurs that compete at bringing the most efficient production techniques to the market. This mechanism is also an important motivating force for rent-seeking entrepreneurs; incumbents in a market have strong incentives to hinder this kind of creative destruction. Since this threatens their wealth, Acemoglu and Robinson (2012) argue that if societies don't have strong enough – or what they call inclusive – institutions this kind of rent-seeking can completely destroy societies. They argue that this is what happened to the Roman Empire, Venice and several other societies that once where wealthy but are not anymore.

Mohtadi and Roe (2003) has developed a two sector endogenous growth

[10]This is not entirely correct, there exists some earlier works. For a well written and interesting read of the development and history of this line of thought see Warsh (2006).

[11]Grossman and Helpman (1991) is another early contribution to this literature.

model that shows that both very young and mature democracies grow faster than countries in the middle stages of democratization. They find that in autocracies the asymmetric distribution of power and privilege tends to isolate policymakers from public responsibility, rewarding rent-seeking activities and thus attracts talented individuals away from wealth creating entrepreneurship. While in democracies it is easier to influence public choice which makes rent-seeking more attractive, but at the same time there are more rent-seekers, this reduce the rent that is possible to obtain through rent-seeking. Furthermore, legal and institutional reforms in response to demands for redistribution lead to greater sanctions and rent-seeking activities.

Corchón (2008) presents a model of the allocation of talent in conjunction with governance, more specifically, he models how this allocation is influenced by autocracy and parliament rule. His model suggest that under autocracy rent-seeking reflects the taste of the autocrat for such activities, while under parliament rule rent-seekers depends on parliament voting. This study shows that under parliament rule the size of rent-seeking may be larger than it is under autocracy. The main conclusion of the paper is that the existence of a parliament is neither a necessary nor a sufficient condition for the decline of rent-seeking. And he argues that this can be seen as casting doubt on the idea that "right" institutions necessarily promote good economic performance.

Works in economic history also deals with this kind of problems see especially the anthology by (Landes, Mokyr, and Baumol, 2010). Several of these works discuss rent-seeking entrepreneurs, and points to different motivations for why the entrepreneur chooses to deploy his talent in rent-seeking activities instead of rent creating ones. Motivations that are often mentioned are; institutions, relative prices, and the reputation of the entrepreneur. All of these elements are important, but the reputation explanation is weak. The logic in this argument is; for some unknown reason entrepreneurs become popular and this leads to more entrepreneurs which results in higher economic growth. This can very well be the case, but there could be an al-

ternative explanation to why favourable reputation for the entrepreneur and wealth creating activities often coincide. It could be the case that the reward system has become more favourable toward wealth creating entrepreneurs, which leads more entrepreneurs to act accordingly. More wealth creating entrepreneurs leads to higher economic growth. And since the creative power of the rent-seeking entrepreneur often is overlooked, this could lead someone to believe that the society has become more entrepreneurial, while what has really happened is that the creative power of the entrepreneur has been channelled toward wealth creating activities. So the important motivational factor is not the reputation of the entrepreneur, but the institutions that determines their reward structure in the economy. If the institutions and reward system is skewed toward rent-seeking entrepreneurs, then entrepreneurs will end up with a bad reputation. For example if one thinks about present day entrepreneurs like Bill Gates and the late Steve Jobs, they have a quite good reputation, while entrepreneurs like Carlos Slim, Mikhail Khodorkovsky and Roman Abramovich don't enjoy an equally pleasant reputation. The latter entrepreneurs have also earned a lot of their wealth through rent-seeking. So my guess is that the causality goes from wealth seeking entrepreneurs through better reputation for the entrepreneur. Non-pecuniary rewards for entrepreneurs are also discussed by Acemoglu (1995, pp. 28–32), he also discusses the question about direction of causality.

The relative prices story is stressed by Allen (2009), as he writes about the Newcomen engine:[12] "Non-adoption was not due to ignorance: the Newcomen engine was well known as the wonder technology of its day . . . , nor was it difficult to lure English mechanics abroad". Allen's argument is that since the Newcomen engine was profitable in Britain it was implemented there, but it was not economical on the continent and consequently not implemented. This explanation is to a great extent coherent with the argument presented

[12]The Newcomen engine was the first practical device that harnessed the power of steam to produce mechanical work.

in this thesis. This also illustrate quite clearly that new technology is not sufficient for wealth seeking entrepreneurs to act, they also need incentives to introduce the new technology to the market. As Douglas North states: "If the basic institutional framework makes income redistribution (piracy) the preferred (most profitable) economic opportunity, we can expect a very different development of knowledge and skills than a productivity-increasing (the twentieth-century chemical manufacturer) economic opportunity would entail" (North, 1990, p. 78).

Up until now I have only briefly touched upon rent-seeking. The term rent-seeking was coined by Krueger (1974), and was first systematically discussed by Tullock (1967). Rent-seeking is a concept that is used to describe the activity when someone attempt to obtain economic rent by manipulating the social or political environment in which economic activities occur, rather than generating new wealth. Examples of activities that are rent-seeking are when somebody tries to obtain a monopoly that is not a natural monopoly; this can be done in several ways. Either by influencing politicians to grant them the right to operate their business as a monopoly or by forcing competing firms out of their market in an illegitimate manner.[13]

It isn't only that the economy could end up in a monopoly position that is the wasteful part of rent-seeking. It is also socially wasteful when economic agents deploy resources to ensure these monopoly rents. Buchanan et al. (1980, pp. 12–14) identify three types of rent-seeking expenditures that might be socially wasteful; (i) the effort and the expenditure of the potential recipient of the monopoly rights, (ii) the effort of that government official to obtain or to react to the expenditure of the potential recipient and (iii) third-party distortions in induced by the monopoly itself or by the government as a consequence of the rent-seeking activity.

Especially point (i) is important when it comes to rent-seeking entrepreneurs,

[13]For a textbook exposition of rent-seeking in the public choice literature see Mueller (2003) especially chapter 15.

if one accepts the assumption that high ability people can choose either to become rent-seeking entrepreneurs or wealth creating entrepreneurs. Then profitable opportunities for rent-seeking can be wasteful from the point of view of the society.[14] This is essentially the Murphy et al. (1991) story. If entrepreneurial rent-seekers are risk takers as Knight (1934) argues, this could have an interesting effect on rent-seeking under point (i). He predicts that the aggregated profit from rent-seeking entrepreneurs on average will be negative owing to the overcompensation for profit by risk-taking entrepreneurs. Mueller (2003, p. 341) notes that this conclusion should hold whether the rents comes from private market investments such as advertising and patenting, or from political markets such as campaign expenditure or lobbying.

Argument (ii) can have at least two detrimental effects on the economy. The first effect could be that the bureaucrat allocates resources toward rent-seeking instead of doing their job; the second effect could be that a result of the rent-seeking done by the bureaucrat can adversely affect R&D and innovation. If this is the case this will result in fewer wealth creating entrepreneurs and lower economic growth, there are several contributions in the literature that models this relationship. A simple, non-technical clear discussion of this problem is given in (Murphy et al., 1993). Chaudhry and Garner (2007) construct a model that incorporates a rent-seeking government that can block innovation into a Schumpeterian growth model. Acemoglu and Robinson (2006) has a similar discussion, Knutsen (2011a,b) discusses how dictators choose to behave when it comes to innovation.

Other interesting studies that deal with rent-seeking are Mehlum et al. (2003a,b), these two articles present a model of how mafia-like activities can affect developing and transition economies. The model that is deployed in these articles exhibits multiple equilibrium and bears some resemblance to

[14]Here it is important to remember that the wasteful effect of rent-seeking is not the transfer of rent from one person to another, but that somebody uses resources to make this transfer happen.

Acemoglu (1995) in this respect. There is also a literature concerning the "veracity effect", which is: "a more than proportional increase in aggregate redistribution in response to an increase in the raw rate of return" (Lane and Tornell, 1996, p. 226) is related to rent-seeking entrepreneurs. More recent contributions that also relate to the "natural resource curse" includes Torvik (2002), Do and Levchenko (2009), Perroni and Proto (2010) and Mehlum et al. (2006) – which tests empirically whether or not resource curses are a result of institutions, their findings implies this to be the case. They show that resource abundant countries with weak institutions have a lower growth rate than resource abundant countries with good institutions. An important point in this article is that entrepreneurs in countries that have institutions that make rents up for grabs goes into this line of business, and this has negative effect on the rest of the economy since, talent are deployed at rent grabbing instead of wealth creating activities.

The above-mentioned studies also points out that wealth creating entrepreneurs often are confronted with legal and environmental constraints. They often need production permits, licenses, dispensations and so on. This can result in request for government intervention and provides opportunities for corruption. Moreover, the socially unproductive transfers that corruption implies may constrain some entrepreneurial activity, given that entrepreneurs may not have equal lobbying power compared to that of established firms, or the same financial resources to pay bribes. This idea can be generalized as: rent-seeking, by jeopardizing current entrepreneurial profits, limits its future transfer opportunities (Mehlum et al., 2003b).

The actual effect of rent-seeking on innovation and economic growth are not always clear cut. If rent-seeking is considered in reference to situations that are not first best, but rather in situation that is more comparable to actual condition in a given jurisdiction, the net effect could be positive, see (Douhan and Henrekson, 2010). As Dejardin (2011) puts it "accepting the rent-seeking behavior of some official (or even taking it as an opportunity)

and bearing the cost of bribery may sometimes be the only way for an entrepreneur to make concrete efficiency-enhancing innovation."

3.1 The cost of rent-seeking

There are several methods for estimating the economic loss from rent-seeking, Del Rosal (2011) gives a good overview. He classifies the approaches to estimating rent-seeking into four categories, (i) Building on the theoretical literature, (ii) direct measures that can be taken as expenditures in rent-seeking, (iii) rent-seeking consequences on a macroeconomic basis and (iv) a group of relevant articles that doesn't fit in to the taxonomy of the other categories. I will mainly concentrate on the studies that fall into category (iii), since these are the most relevant for the question investigated in this thesis. I note the estimates in category (i) and (ii) fall into a wide range from 3% of GNP (Posner, 1975) to 30–45% of GNP (Mohammad and Whalley, 1984).[15]

There are some papers on rent-seeking and growth, most of these papers only present an empirical study with no theoretical model underpinning there empirical findings. In the eleven papers that Del Rosal (2011) surveys, only two have a theoretical model, these papers are Magee et al. (1989, chapter 8) and Murphy et al. (1991). Both of these studies use the number of lawyers as a proxy for rent-seeking. Other studies use this proxy as well and also find a negative effect on economic growth from the numbers for lawyer e.g., see Courbois (1991); Laband and Sophocleus (1988).

There are also works on rent-seeking that attempt to link it with political regimes, for example Dougan and Snyder (1993) studies the relationship between government revenues and the political regime, they study authoritarian versus democratic. Their finding implies that authoritarian regimes tend to be associated with higher ratios of tariff revenues than do democracies.

[15] An even lower estimate is given in Mixon and McKenzie (1996), which comes up with no effect of rent-seeking. This is done in an econometric framework.

A paper by Svensson (2000) provides a study on the interaction between the political process and foreign aid. His finding put forward that foreign aid is linked with higher level of corruption; the proxy that is employed for rent-seeking is ethnic diversity.

4 Theory

In this section I will present two models where rent-seeking entrepreneurs influences the economy. The presentation of these models follows closely the presentations given in the original articles.

The first model Murphy et al. (1991) develops a framework for studying how talent is allocated between two sectors in the economy. This model demonstrates that if one sector is more open to rent-seeking and at the same time this is a sector with the most talented entrepreneurs, this will have negative consequences for the growth rate of the economy.

The second model Acemoglu (1995) develops a framework that shows that the level of rent-seeking in an economy can have effects on the investment rate. If there is a high level of rent-seekers; the model demonstrates that this will result in a lower investment rate, since wealth-creating entrepreneurs will not be the full recipient of their effort. The model also demonstrates that there could be multiple equilibriums and that path dependency can make it hard to break loose from an undesirable equilibrium.

4.1 Model for allocation of talent Murphy et al.

The model I present here is a two-sector growth model; the model is taken from Murphy et al. (1991), and is based on Lucas (1978). In this model people with high-ability becomes entrepreneurs and hire low-ability people in their firms. The model has two types of entrepreneurs, wealth creating and rent-seeking. In the population there is a distribution of abilities $(1, a)$ with a density function $f(A)$. An individual's ability is measured by how much he can improve the technology which he operates. Ability in this model is one-dimensional. Each person lives for one period and the distribution of abilities is static. The economy consists of only one good, which is produced by many firms. Each firm is organized by an entrepreneur. A firm that is

organised by an entrepreneur with ability A, has profit given by

$$y = s \cdot A \cdot F(H) - w \cdot H. \tag{4.1}$$

Where s is the common state of technology, F is the static over time production function, H is the aggregate ability of all workers employed by this entrepreneur, w is the workers' wage and price of the good is normalised to 1. Entrepreneurs takes the current state of technology s and the wage w as given. Rent-seekers in this economy will cost the wealth-creating entrepreneur an amount T, so this leaves the profit for the wealth creating entrepreneur to be $(1 - T)y$.

The profit function given in (4.1) embodies the key assumption in this model, which is that abler entrepreneurs can earn more than proportionally to their ability from operating the same technology as the less able entrepreneurs i.e., increasing return to ability. This is due to the property of A, which only affects profits not cost. The concavity of the production function F determines how the diminishing returns to scale affects the economy and how many entrepreneurs that operate in it.

The first-order condition of 4.1 with respect to H is given by

$$s \cdot A \cdot F'(A) = w. \tag{4.2}$$

Equation 4.2 implies that more able people run larger firms. The model has a possibility of only one entrepreneur, in the extreme case of constant return to scale. A person becomes one of the two types of entrepreneurs when

$$s \cdot A \cdot F(H(A)) - w \cdot H(A) > w \cdot A, \tag{4.3}$$

and a worker otherwise. The more able people become entrepreneurs in equilibrium, and the less able ones become workers. There are two cut-off ability levels A^* and ξ, such that those with higher abilities become one of the

two types of entrepreneurs and those with an ability lower than A^* become workers.

In equilibrium the wage adjust until the combined demand for workers by the wealth creating and rent-seeking entrepreneurs is equal to the supply of workers:

$$\underbrace{\int_1^{A^*} Af(A)dA}_{\text{workers}} = \underbrace{\int_{A^*}^{\xi} Af(A)dA}_{\text{rent-seekers}} + \underbrace{\int_{\xi}^{1} Af(A)dA}_{\text{wealth creator}} \tag{4.4}$$

or

$$\underbrace{\int_1^{A^*} Af(A)dA}_{\text{workers}} = \underbrace{\int_{A^*}^{\xi} Af(A)dA}_{\text{wealth creators}} + \underbrace{\int_{\xi}^{1} Af(A)dA}_{\text{rent-seekers}}. \tag{4.5}$$

Each person in the model lives for one period and has three choices, wealth creating–, rent-seeking entrepreneur and worker. If he becomes an wealth creating entrepreneur, he picks the size of his firm $H(A)$ according to (4.2) and earns a profit given by (4.1). The technology that is deployed by the rent-seeking entrepreneur is also subject to increasing returns to ability and diminishing returns to scale. It is assumed that the rents collected by a rent-seeking entrepreneur with ability A is given by

$$R = \frac{A \cdot G(H) \cdot T \cdot Y}{\underbrace{\int AG(H)f(A)dA}_{\text{rent-seekers}}} - w \cdot H, \tag{4.6}$$

where H is the total human ability of workers that this rent-seeker employs, Y is the aggregate profit of the entrepreneur and $G(H)$ is the concave production function for the rent-seeking entrepreneur. Here the share of total gross rents $T \cdot Y$ collected by the rent-seeking entrepreneur of ability A is proportional to $A \cdot G(H)$. This means that the total gross rents collected by rent-seeking entrepreneur automatically add up to the total revenues lost by the wealth creating entrepreneur.

The growth in this economy comes from last period's best practice; this means that the most able entrepreneur that operates in the wealth creating sector determines the growth rate. It is assumed that the rent-seeking sector has no productive component and hence does not contributes to the growth rate. It is assumed that the state of the technology today is the state of the last period times the ability of the ablest wealth creating entrepreneur in the last period[16]:

$$s(t) = s(t-1)\cdot(\text{maximum ability of an wealth creating entrepreneur at } t-1). \tag{4.7}$$

Equations 4.4 and 4.5 give the two different states the economy can operate under. Which state an economy operates in is determined by the elasticities of the production function (F) and (G) whit respect to H. If the economy is in the state described by 4.4, then the most talented person in the economy has become a wealth creator. This happens because wealth creating is the most profitable option for this person in this economy. The result is that the economy will experience its maximum growth rate – given by the ability of the ablest person – described by equation 4.7. But since there are rent-seekers present in this economy the level of income will be lower than it will be without rent-seekers. The size of this income reduction due to the rent-seeker is determined by the area between A^* and ξ in 4.4.

The state described by equation 4.5 arises when the most profitable opportunities are in rent-seeking. When this happens this will have detrimental effects on the economy, the most important effect is that the growth rate of the economy will be lower than it otherwise would have been if wealth creating had been the more profitable choice. The reason is that now the most talented person in the economy has become a rent-seeker and since rent-seeking doesn't add to the growth rate of the economy, the growth rate will

[16]This is also affected by the "genius explanation" of economic growth. Which states that a larger population will tend to bring about more technological advances, due to higher probability for geniuses see e.g. (Kuznets, 1960; Kremer, 1993).

be determined by less able people. How much lower the growth rate will be is determined by the size of the rent-seeking sector. The rent-seeking sector also has an income-reducing effect in the same manner as it has under the state described by equation 4.4.

In section 5 below, I have tried to empirically test this relationship. This is done by using the college enrolment rate in social science, business and law as a proxy for rent-seekers and the college enrolment rate in engineering as a proxy for wealth creators. I have followed the method used in Murphy et al. (1991), I use updated data and conduct a thorough robustness check of the results.

4.2 An equilibrium model of the allocation of talent (Acemoglu, 1995)

The model assumes that each agent has some talent, and that these talents can be employed in two areas:

1. Productive activities, which is called entrepreneurship.

2. Unproductive activities, i.e., activities that bring positive return to the individual but not to the society.

In this model, it is also assumed that the economy consists of a continuum of identical agents, which is normalised to 1. Entrepreneurs in the model undertake an ex ante investment that will determine their total production. This production is equal to $\alpha + x$ where x is the ex-ante investment. Investment is chosen for the set $[0, \infty)$ and has a cost $c(\cdot)$ which is convex in the set $[0, \infty)$, which means $c'(\cdot) > 0$ and $c''(\cdot) > 0$, $\lim_{x\to\infty} c'(x) = 0$ and $c(0) = 0$. The entrepreneur is not able to keep all the revenue that he produces; there is a probability that he will have to deal with a rent-seeker who will demand a bribe. This leads to the entrepreneur losing a proportion $(1-q)$ of his total product. It is assumed in the model that the probability of having to deal

with a rent-seeker is equal to the proportion of rent-seekers in the economy, represented by p. This implies that the net return for the entrepreneur equal to

$$(1 - p + pq)(\alpha + x) - c(x). \tag{4.8}$$

Gross revenue of entrepreneurship is $\alpha + x$, the revenue is retained by the entrepreneur with a probability $(1 - p)$ and only a proportion q of it with probability p, while the cost of investment is always sustained. It is assumed in the model that all agents are wealthy enough to be able to undergo the start-up investment without having to run into credit difficulties. The investment level is set to maximize this return which implies

$$x(p) = \delta(1 - p + pq), \tag{4.9}$$

where $\delta(\cdot)$ is the inverse function of $c'(\cdot)$, and $c''(\cdot)$ implies that $x(p)$ is concave in p. Form equation 4.9 one sees that $p > 0$ leads to underinvestments on the part of the entrepreneur, since they are not the full recipient of their effort.

For a rent-seeker the payoff depends on the likelihood of obtaining bribes from entrepreneurs. b denotes the proportion of agents that are entrepreneurs, the bribe that a rent-seeker receives from an entrepreneur is denoted by $R(p)$. The amount that the rent-seeker is able to extract from an entrepreneur can be a decreasing function of p because of competition among rent-seekers or because the gross revenue of entrepreneur is decreasing in p – since they choose to invest less.

It is also assumed that $R'(\cdot) \leq 0$ and $R''(\cdot) \leq 0$. Thus, the expected return to a rent-seeker to be given by

$$bR(p), \tag{4.10}$$

from equation 4.8 there are pb entrepreneurs which meets a rent-seeker and from equation 4.10 exactly the same number of rent-seekers meets an entrepreneur. Since all agents in this economy are identical – it follows that

they must have the same expected return. And since $b = 1 - p$ this gives

$$\underbrace{(1 - p + pq)(\alpha + x(p)) - c(x(p))}_{\text{expected net return to wealth creating entrepreneurs}} = (1 - p)R(p) \tag{4.11}$$

The RHS of equation 4.11 is the return that the entrepreneur can expect to earn if he chooses to become a rent-seeker.

I will refer to the LHS of equation 4.11 as V_E and RHS as V_R, Using the first-order condition and equation 4.9, we can see that

$$\begin{aligned} \frac{dV_E}{dp} &= -(1 - p)(\alpha + x(p)) \quad < 0, \\ \frac{d^2V_E}{dp^2} &= -(1 - p)x'(p) \quad > 0 \end{aligned} \tag{4.12}$$

and

$$\frac{dV_R}{dp} = -R(p) + (1 - p)R'(p) < 0. \tag{4.13}$$

Since both curves are downward sloping – shown in figure 1 – there can be more than one intersection, how many are determined by the relative position of these curves. There is no equilibrium where everyone becomes a rent-seeker, to see this set $p = 1$ this gives $V_R = 0$ but $V_E > 0$ since $p > 0$. Let us now consider the following conditions:

$$\alpha + x(0) - c(x(0)) > R(0) \tag{A}$$

$$\exists p^* \text{such that} (1 - p^* + p^*q)(\alpha + x(p^*)) - c(x(p^*)) < (1 - p^*)R(p^*). \tag{B}$$

Condition A states that when there is no rent-seeking, the return to rent-seeking is lower than that to entrepreneurship. Condition B tells us that at some level of activity in the economy, rent-seeking is the more profitable option. From these results we could state the following:

Proposition 1. 1. When condition A is satisfied but B is not satisfied,

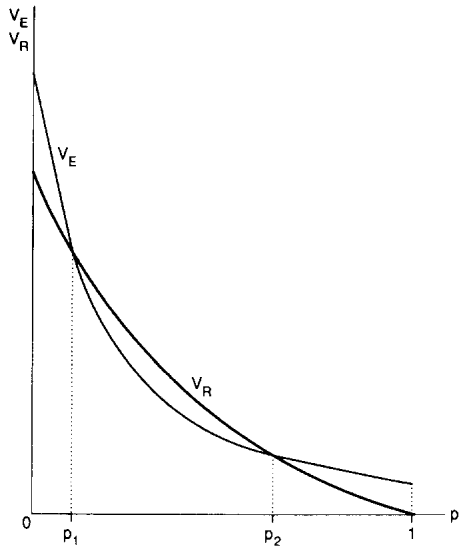


Figure 1: Multiple equilibrium[a]

[a]Source: Acemoglu (1995, p. 22)

there exists a unique equilibrium in which no agent chooses to become a rent-seeker.

2. When both conditions are satisfied, there exist at least three equilibria, equilibriums, one without and the others with rent-seeking.

Proof. The proof follows from figure 1 and equation 4.11. Supposed condition A is fulfilled; the curve V_E starts perpendicularly above V_R which implies that when there is no rent-seeking, the return to rent-seeking is less than to entrepreneurship. Thus a situation deprived of any rent-seeking is an equilibrium. Whether there are any more equilibria rest on the position of the two curves. When assumption B is not satisfied, V_E never falls below V_R, thus the unique equilibrium is given by the point $p = 0$. However, when V_E falls below V_R at lease two more intersections must exist, since at $p = 1$ we know that $V_E > V_R$. □

In the original paper Acemoglu expands the model so it becomes dynamic; he shows that the model will have at least three equilibria. And that two of these are stable – high level of rent-seeking and low level of rent-seeking – he also has a very interesting discussion of the political economy of the allocation of talent. In this example there is introduced a police force into the dynamic model. The size of this police force can either be determined by a government or by the preference of agents in the economy through voting. A larger police force reduces incentive to choose rent-seeking i.e., V_R shifts down in figure 1, as a result entrepreneurship will be a more attractive choice for future generations and unless the larger police force is prohibitively costly, social welfare will increase.

4.3 Applying the models

The two models I have presented above highlights how rent-seeking affects the society, the Murphy at al. model demonstrates how rent-seeking in combination with the allocation of talent can negatively affect economic growth. The Acemoglu model demonstrates how different level of rent-seeking can affect the investment rate in the economy. As for all economic models one has to ask oneself the important question, are these models able to explain real life events? Indeed, the analysis done in Murphy et al. (1991) shows that the main implication from these model finds support in the data. The original results are reproduced in appendix B, as I show in section 5 I am not able to reproduce these results.

In the empirical part of the thesis I try to estimate the effect of rent-seeking entrepreneurs on the economy. Most of my regression fails to show significance, and I am therefore not able to point to which of the two models that best explains how rent-seeking entrepreneurs affects the economy. The plan was to see this by looking at the direct and indirect effects of the law and engineering variables that I deploy. So I can only refer to what Murphy et al. (1991) finds in their article: "the evidence from the reduced sample

might mean that the most important effect the lawyers on growth is the opportunity cost of not having talented people as innovators. The small indirect effect suggests that lawyers reduced growth creating activities but not through reducing the incentive to invest."

The only thing I could point to in my findings is the strange behaviour of the law variable in the jackknifing estimation done in section 5.4, especially the figure 3e and 3g. These findings could suggest that lawyers have different effect in different countries, and that in some countries they are growth enhancing and in others they have a negative effect on growth. This could also point to the case of multiple equilibria put forward by the model in Acemoglu (1995).

I also think it is possible to look at historical events, and make certain claims that the models highlights what's were going on. For example the Murphy at al. model can illuminate what was going on in Russia between the 80s and up until now. In the early 80s through the early 90s Russia was in a state described by 4.5 i.e., if you where an ambitious young Russian at the time you would have join the bureaucracy or the KGB to try to enrich yourself. Unfortunately for you this system was overstretched – there were too much rent-seeking going on – and the system collapsed in 1991.

Following the collapse of the Soviet Union, the new governments in the post-Soviet and other ex-communist states carried out "shock therapy" that gave talented people – with often a background in engineering[17] – an opportunity to take control of some of the biggest companies in Russia. At this time in the 90s talented people gravitated towards the private market, and it is in some sense possible to argue that the Russian economy at that time was in a state described by 4.4. I know that this is highly disputed – there

[17]Most of the people know as the Russian oligarchs are engineer graduates; Boris Berezovsky was a mathematician , Mikhail Khodorkovsky was a bureaucrat/politician, Alex Konanykhin studied at Moscow Institute of Physics and Technology, Mikhail Fridman graduated from Moscow Institute of Steel and Alloys, Vitaly Malkin holds a doctorate from Moscow Institute for Transport Engineering and Vladimir Potanin is an economist.

was a lot of rent-seeking going on at the time – but it is also true that the Russian economy had a high growth rate at that time and that the oligarchs and people working for them where highly talented.

This all changed in the early 2000's when Vladimir Putin became president; he took control of the private market and redistributed power from the oligarchy to the Russian state. The result of this was that talented people started to gravitate toward the bureaucracy instead of taking up work in the market, it can be argued that the economy returned to the state described by 4.5, see the Economist (2010) "surveys now show that the young would rather have a job in the government or a state firm than in a private business".

The model by Acemoglu can also describe historical events, there have been put forward numerous explanations for why the Industrial Revolution happened in England. I have touched upon some of them in section 3. I think Acemoglu's model can contribute to this discussion. Mokyr (2010) argues that during the Industrial Revolution there was a "gentleman mentality" that made business much easier. This in turn channeled entrepreneurs in to wealth creating entrepreneurship. One of the things this gentlemen mentality did was to make credit more available for the entrepreneur's. This was extremely important at the time – since the possibility of getting capital through joint stock were nearly impossible – due to the Bubble Act.[18] Therefore the entrepreneurs needed this kind of networks to make the credit market function. Munro (2010, p. 137) speculates that: "[V]irtual absence of joint-stock financing made entrepreneurial profit reinvestment (or profit retention) all the more important for industrial capital formation during that early, pre-1825 phase, of the Industrial Revolution."

In the Acemoglu model this will be represented by either that it is only condition A that holds, or that the level of p^* in condition B is such that there exists an equilibrium with a low level of rent-seeking. From what is argued

[18]The Bubble Act or more formally "statute 6 George I cap. 18" was an Act of the Parliament of Great Britain that forbade all joint-stock companies not authorised by royal charter Munro (2010).

by Mokyr (2010) most of the rents created by the inventions during the Industrial Revolution were collected by the entrepreneur and his financier. The most probable is that England at this time was in an equilibrium with low level of rent-seeking. Leading to a higher investment rates than under previous equilibriums with higher amount of rent-seekers. Low level is meant in historical terms and in comparison with other countries at the time, the level of rent-seeking during the Industrial Revolution was probably higher than what it is today.

It could of course be the Murphy at al. story that explained the Industrial Revolution, but this does not seem plausible, since most of the occupations that are lucrative for conducting rent-seeking were closed to most of the talent pool. As Mokyr (2010, p. 186) points out; "[C]areers in the military, the civil service, and politics were still by and large reserved to members of the privileged Anglican landowning classes."

5 Empirical testing of Murphy et al. (1991)

> "I checked it very thoroughly," said the computer, "and that quite definitely is the answer. I think the problem, to be quite honest with you, is that you've never actually known what the question is."
>
> – Douglas Adams, *The Hitchhiker's Guide to the Galaxy*

In this section I re-estimate the results from Murphy et al. (1991). The main finding in the original study is that there is reason to believe that there is a positive relationship between the share of students in engineering and economic growth and a negative relationship when it comes to the share of students enrolled in law. I am only able to some extent to corroborate their results.

5.1 Data

The dataset I use constitutes of seven variables with 103 observations. Table A.I in appendix A gives an overview of which countries that are included in the dataset and which year the different variables span. The left-hand side variable is average yearly percentage GDP growth in the period 1998–2009. The variable is calculated from the variable "rgdpl" found in Penn World Table (PWT) version 7.0 Heston et al. (2011).[19] Specifically at the variable "rgdpl" stands for: real GDP per capita (2005 constant price international dollar: laspeyres). The variable log(rgdpl.1983) is the logarithm of the level of GDP in 1983, it is included for controlling for convergence in the growth rates, this variable is also from Heston et al. (2011). This variable did not have observations on all the 103 countries that are included in the dataset. I have therefore used the closest observation, unfortunately there is sometimes

[19]The method I have used for calculating is: $\left(\left(\left(\sqrt[11]{\frac{\text{GDP}_{2009}}{\text{GDP}_{1998}}}\right)-1\right)\times 100\right)$ = average yearly percentage GDP growth.

a considerable time gap between when the variable should ideally have been recorded and when it actually is recorded.[20] As can be seen from table 8 the inclusion of these observations changes the results considerably. More on this below in section 5.4. "ki" and "kg" is the investment share and the consumption share of real GDP respectively also Heston et al. (2011).

Primary.school.enrollment.1983 is the variable "SE.PRM.ENRR" from the world development indicators (WDI) World Bank (2012). This variable measures enrolment in primary school as a percentage of the population that was eligible for primary school in 1983. This variable is also ridden by the problem that not all countries have observations for 1983.[21]

The variable coups are from Polity IV (2010) Coups d'Etat data, the variable corresponds to "numbers of revolution and coups" in the original study – I have made a dummy variable that take the value 1, if one of four conditions – successful, attempted, plotted, and alleged coup events – in the polity IV Coups d'Etat data is true during the time period 1998–2009. The original source for the viable used in Murphy et al. (1991) was Banks (1979), since this data is behind a pay wall I had to use data from another source.

The Source for the variables law– and engineering share is UNESCO Institute for Statistics UIS (2012). These variables doesn't map completely onto the variables used by Murphy et al. (1991). The reason for this is that UNESCO has changed the coding for these variables. The biggest difference is between the law share used in the original study and the one that I make use of. My variable is much broader than the the one used in their study. The full name of my variable is: "Enrolment in social science, business and law". This means that social science and business is also included, in addition to law. I don't see this as a major problem; since people trained in social

[20]Countries with missing observations: Azerbaijan, Croatia, Czech Republic, Eritrea, Estonia, Georgia, Kyrgyzstan, Latvia, Libya, Lithuania, Macedonia, Qatar, Saudi Arabia, Slovak Republic, Slovenia and Tajikistan.

[21]Countries with missing observations : Azerbaijan, Croatia, Eritrea, Georgia, Kyrgyzstan, Liberia, Lithuania, Macedonia, Namibia, Romania, Saudi Arabia, Slovak Republic, Tajikistan and Uzbekistan.

science and business often are often find in the same line of work as people with a law degree, and should therefore be equally good at rent-seeking. The observation contained in the engineering share variable is: "Enrolment in engineering, manufacturing and construction." The engineering variable seems to map the original data better. An indication that this is the case can be seen from table 2 and B.II. Here one could see that the mean value of engineering in 1970 was 10.39% and in 1998 12.48%, while the change in the law variable is much larger. The mean of the law variable in 1970 was 8.89% and in 1998 33.19%.

Another problem with the data on these two variables was that not all countries recorded data in the year 1998. I therefore had to use observations from the closest year to 1998, there were often a substantial time gap between when the variable actually was recorded and when it's ideally should have been recorded. Table A.I in appendix A presents a complete list of which year the different variables that are used in the dataset are recorded. As can be seen from comparing table 2 and B.II, the change in the engineering share variable between 1970–1998 was only 1.28 percentage points. This gives me reason to believe that the year by year change of the law and engineering variables are small. I therefore think it is acceptable to use observations from later years as a proxy for observation in 1998.

5.2 Results

I have followed Murphy et al. (1991) quite closely when I have conducted these regressions. As they did I find that some of the variables in the regressions are statistically significant. I will first start with a short description of the original findings, I have reproduced the original tables in appendix B table B.II to B.VI.

When they run regressions for the full set of countries and only controls for GDP level in 1960, there findings is that there is a positive relationship between engineering and growth, for law this relationship is insignificant but

Table 2: Summary statistics for engineering and law majors as percentage of college students

	Full sample		Countries with 10,000 or more students	
	Engineering	Law	Engineering	Law
Mean	12.48	33.19	13.76	33.41
Median	11.49	33.48	12.23	33.48
25th percentile	7.43	26.66	9.20	26.60
75th percentile	17.34	40.45	18.05	40.46

has the "correct" sign. This result can be found in table B.II.

When they include more of the variables that are common in cross section growth regressions – investment share, government consumption share, primary school enrolment and revolution and coups – they don't find as significant relationship on the full sample. But when they reduce the sample and only include countries with more than 10,000 students they find a statistically significant relationship between economic growth and engineering – and law share. Results can be found in table B.III. As I will show in section 5.4 – based on my dataset – it is possible to find the results you want just by being lucky whit which countries are included and not included based on arbitrary exclusion criteria.

It is impossible for me to say if this is the case with the original data – despite strenuous efforts – I have not had any luck at tracking down the data used in the original article.[22]

From table B.IV one can see that in the original study, the effects of law enrolment on growth are trivial. As I point out on page 25, the interpretation of this is that the most important effect of lawyers on growth is the loss of talent, that otherwise could have been deployed more economically.

I first run the regression were I only included the law–, engineering share variables and the log of real GDP per capita in 1983. As can be seen from ta-

[22]I have emailed all of the authors of the original article and asked them for the dataset, but they haven't responded.

Table 3: Regression of growth on proportions of majors in engineering and law

	All countries	> 10,000 Students
(Intercept)	5.43^{**}	10.09^{***}
	(1.93)	(2.04)
log(rgdpl.1983)	-0.31	-0.72^{***}
	(0.20)	(0.20)
law.share	-0.02	$-0.04^{\dagger}$
	(0.02)	(0.02)
engineering.share	0.04	0.03
	(0.03)	(0.03)
N	103	85
R^2	0.04	0.15
adj. R^2	0.01	0.12
Resid. sd	2.36	2.03

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

ble B.III, Murphy et al. (1991) finds a strong significant relationship between engineering and growth, in contrast with my results found in table 3 they don't find a statistically significant relationship between law and growth. My result is significant at a 10% confidence level. That the log(rgdpl.1983) is negative and significant is as expected, and suggests that there has been convergence and that low income countries grow faster than high-income countries. This is in line with the Solow growth model.

When comparing my result with the original results, one sees that the original findings are much stronger than what I have been able to find. As I will show in section 5.4 this could be due to which countries are included and which are not.

I have followed the original study and run the regression on a subset of the observations were college enrolment is higher than 10,000. The reason for why this is done is to reduce the problem of college attendance abroad. Murphy et al. (1991) argues that this approach is preferable than to run

population weighted regressions, since some large population countries have a significant commitment to education abroad. By looking at my result and contrasting them with the original results one sees that college enrolment has probably risen since 1970. Since there are only eighteen countries with less than 10,000 students enrolled in college.

In table 4 I have run the full regression model as the table shows both law and engineering fall short of being significant. They both show the "right" signs negative for law and positive for engineering. In the original paper they decompose the effect of engineering and law into direct and indirect effects, I think it's a bit farfetch to do that here since my results fall short of being significant. So I have therefore dropped this. The regression model that I have used for the regressions in table 4:

$$\begin{aligned}\log\left(\text{GDP per capita}\right)_{i,2009} = \beta_0 &+ \beta_1 \log(\text{GDP per capita})_{i,1983} \\ &+ \beta_2(\text{kg})_{i,1998} + \beta_3(\text{ki})_{i,1998} + \beta_4(\text{law.share})_{i,1998} \\ &+ \beta_5(\text{engineering share})_{i,1998} \\ &+ \beta_6(\text{Primary school enrollment})_{i,1983} \\ &+ \beta_7(\text{coups})_i + \epsilon_i \qquad (5.1)\end{aligned}$$

.

The β coefficient for "kg" in table 4 is somewhat confusing, for the reduced sample "kg" is positive and significant at a 10% level. This is not in line with theories of rent-seeking where government consumption mostly is seen as growth reducing. The fact the β coefficient for coups is positive and significant is also very strange, I am not able to offer any explanation for this relationship. The primary school enrolment variable is significant and positive in both the regressions, this is expected to be the case and show similar results as Murphy et al. (1991) The results are also in the same ballpark 0.03 vs. 0.02 for "All countries".

Table 4: Determinants of growth rate of real GDP per capita between 1998 and 2009

	All countries	> 10,000 Students
(Intercept)	4.26*	6.42*
	(2.08)	(2.82)
log(rgdpl.1983)	−0.43*	−0.79***
	(0.20)	(0.17)
kg	−0.00	0.01†
	(0.01)	(0.01)
ki	0.00	0.01
	(0.00)	(0.01)
law.share	−0.03	−0.04
	(0.02)	(0.03)
engineering.share	0.04	0.04
	(0.03)	(0.03)
Primary.school.enrollment.1983	0.03**	0.02†
	(0.01)	(0.01)
coups	1.63†	1.56
	(0.85)	(1.91)
N	103	85
R^2	0.16	0.27
adj. R^2	0.09	0.20
Resid. sd	2.26	1.94

Standard errors in parentheses (Robust standard errors for "> 10,000 Students"
† significant at $p < .10$; *$p < .05$; **$p < .01$; ***$p < .001$

5.3 Regression diagnostics

5.3.1 Detecting the presence of heteroscedasticity

The problem of heteroscedasticity arises when the error term ϵ doesn't fulfil the criteria of having a uniform variance, i.e., $E\epsilon_i \neq \sigma^2$. If there is presence of heteroscedasticity in the data, the OLS estimator is still unbiased but since ϵ doesn't have a uniform variance the standard errors of the β coefficient are larger. There are several ways of detecting heteroscedasticity; one simple way to go about is looking at a residual plot. The residual plot for the regression

Table 5: Auxiliary regressions

	All countries	$> 10{,}000$ Students
Auxiliary regressions Engineering		
(Intercept)	2.16	2.54
	(5.69)	(6.96)
log(rgdpl.1983)	1.29^{*}	1.14
	(0.59)	(0.72)
ki	0.01	0.02
	(0.01)	(0.02)
Primary.school.enrollment.1983	0.00	-0.01
	(0.03)	(0.03)
kg	-0.02	0.00
	(0.02)	(0.03)
coups	-3.42	-4.05
	(2.62)	(2.80)
Auxiliary regressions Law		
(Intercept)	43.60^{***}	45.47^{***}
	(8.25)	(8.99)
log(rgdpl.1983)	-2.04^{*}	$-1.75^{\dagger}$
	(0.86)	(0.93)
ki	-0.00	-0.03
	(0.02)	(0.02)
Primary.school.enrollment.1983	0.10^{*}	0.14^{**}
	(0.04)	(0.04)
kg	-0.03	-0.08^{*}
	(0.02)	(0.03)
coups	-3.12	-7.63^{*}
	(3.79)	(3.62)

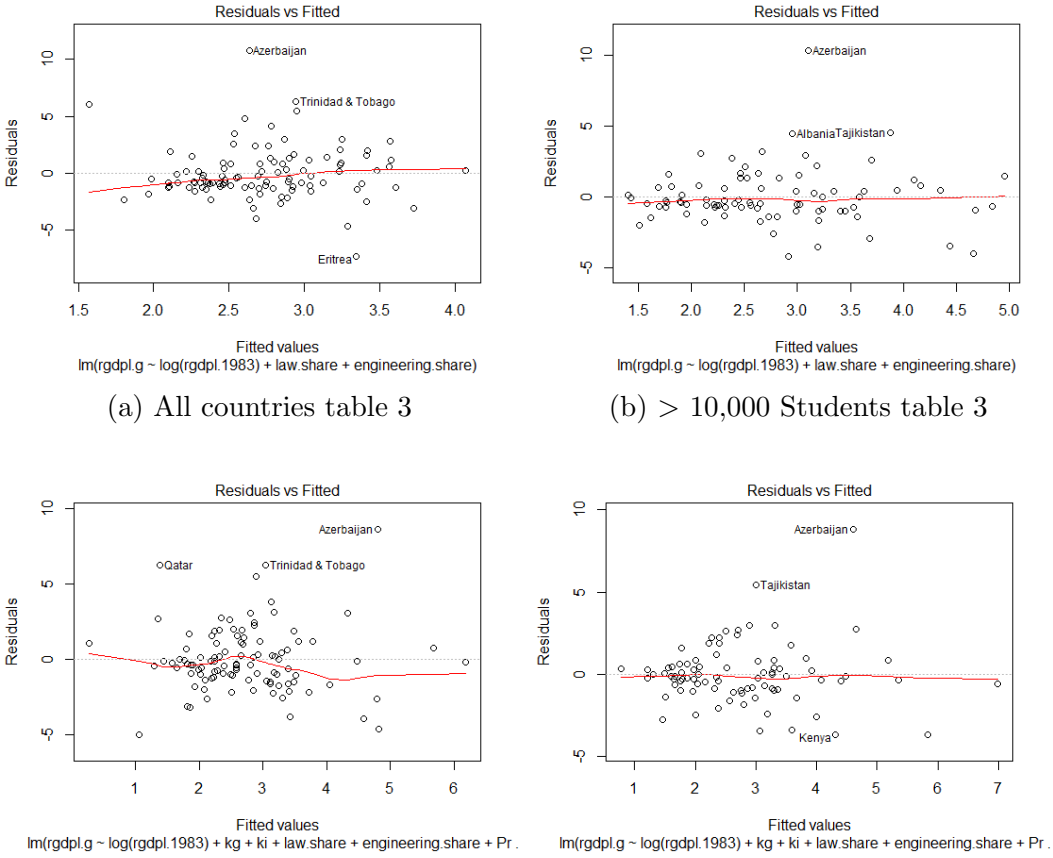
Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

run in table 1 can be found in figure 2.

From the plot in figure 2 there is reason to believe that heteroscedasticity might be a problem, I therefore conduct an Breusch-Pagen test[23] (B-P),

[23]The test was independently suggested by Breusch and Pagan (1979) and Cook and



(a) All countries table 3

(b) > 10,000 Students table 3

(c) All countries table 4

(d) > 10,000 Students table 4

Figure 2: Residuals

the key idea behind this test is based on viewing the squared residuals as "estimates" of the variance of the respective observations error. For the B-P test the H_0 is homoskedastisity and H_1 is heteroscedasticity. For the regressions run in table 3, the B-P test shows for "All countries": BP = 6.29, df = 3, p-value = 0.098 and for "> 10,000 Students": BP = 5.04, df = 3, p-value = 0.169. From the result that the B-P test gives there is no reason to believe that there is a problem with heteroscedasticity in the data

Weisberg (1983)

underlying the result given in table 3, I cannot reject the null hypothesis of homoskedastisity at a 5% significance level.

The B-P test for "All countries" in table 4 is BP = 13.19, df = 7, p-value = 0.068, This means that I cannot reject homoscedasticity at a 5% significance level. For "> 10,000 Students" the test shows: BP = 19.35, df = 7, p-value = 0.0072 which gives me reason to reject H_0 and and accepts H_1,t this regression suffer from heteroscedasticity at a 5% significance level.

A common way to remedy the effect of heteroscedasticity is to use so-called robust standard errors, which could be calculated from using the covariance matrix. There exist several ways of estimating this matrix, the first estimation technique was suggested by White (1980). The estimation technique I use here is develop by MacKinnon and White (1985).

For the regression model given in 5.1 rewritten in matrix form: $y_i = x_i^\top \beta + \epsilon_i$ the coeffients β can be consistently estimated by OLS by using the OLS estimator $\hat{\beta}$ with an OlS residuals $\hat{\epsilon}_i$ is given by:

$$\hat{\beta} = X^\top X)^{-1} X^\top y \tag{5.2}$$

$$\hat{\epsilon} = (I_n - H)u = (I_n - X(X^\top X)^{-1} X^\top)\epsilon \tag{5.3}$$

where I_n is the n-dimensional identity matrix and H is the hat matrix. The standard covariance matrix in an OLS model is given by:

$$\Psi \ = \ \mathrm{VAR}[\hat{\beta}] = \left(X^\top X\right)^{-1} X^\top \Omega X \left(X^\top X\right)^{-1} \tag{5.4}$$

.

What kind of estimators that should be used for Φ depends on the assumptions about Ω, for OLS it is assumed that the residuals are homoscedastic whit variance σ^2 which yields $\Omega = \sigma^2 I$ and $\Phi = \sigma^2 (X^\top X)^{-1}$ which can be consistently estimated by plugging in the OLS estimator $\hat{\sigma}^2 = (n-k)-1 \sum_{i=1}^{n} \hat{u}_i^2$. This is the regression method that underlies the OLS estimation done in all the regressions found in this thesis, except the regression

that underlies the results are given in table 4 column "> 10,000 Students".

The B-P test given above shows this regression suffers from heteroscedasticity. I therefore have to use and at the estimation of Ω than $\Omega = \sigma^2 I$. This is done by using $\hat{\Omega}$ instead of Ω in 5.4, more specifically replacing the diagonal elements of Ω whit $\hat{\Omega} = \text{diag}(\omega_1, \ldots, \omega_n)$ where ω_i is:

$$\omega_i = \frac{\hat{\epsilon}_i^2}{(1 - h_i)^2} \tag{5.5}$$

where $h_i = H_{ii}$ are the diagonal element of the hat matrix.

5.3.2 Detecting the presence of multicollinearity

Multicollinearity is not a severe problem for ordinary least square estimation, the reason for this is that multicollinearity doesn't lead to bias of the β coefficients. Multicollinearity only leads to higher variance of the OLS estimator, the R^2 statistic is unaffected and OLS is still the best linear unbiased estimator.

Table 6: Correlation matrix

	log rgdpl 1983	kg	ki	law share	engineering share	Primary school	coups
rgdpl	1.000	-0.101	0.209	-0.164	0.260	0.221	-0.113
kg	-0.101	1.000	-0.125	-0.141	-0.172	-0.202	0.034
ki	0.209	-0.125	1.000	0.008	0.130	0.178	-0.062
law	-0.164	-0.141	0.008	1.000	-0.081	0.220	-0.081
engineering	0.260	-0.172	0.130	-0.081	1.000	0.106	-0.160
Primary	0.221	-0.202	0.178	0.220	0.106	1.000	-0.102
coups	-0.113	0.034	-0.062	-0.081	-0.160	-0.102	1.000

There are several methods for detecting multicollinearity; I will present two methods here. The first method is to look at the correlation matrix; this matrix can be found in table 6. By looking at this table there is no reason to believe there is a problem with multicollinearity. But just to be sure that this is correct I will also use the inverse of the correlation matrix. The diagonal

elements of this matrix are called variance inflation factor (VIF), and are given by $(1 - R_i^2)^{-1}$ where R_i^2 is the R^2 from regressing the ith independent variable on all the other independent variables.

Table 7: Variance inflation factor

Dependent varible	VIF_i
log(rgdpl 1983)	1.204
kg	1.092
ki	1.078
law share	1.138
engineering share	1.130
Primary school enrollment 1983	1.178
coups	1.047

According to Kennedy (2008, p. 199) a $\text{VIF}_i > 10$ indicates harmful collinearity, as seen from table 7 this is not the case here. This leads me to conclude that multicollinearity is not a problem in this regression.

5.4 Sensitivity

As pointed out above, I am not able to fully recreate the results from the original article. For me this was a bit surprising, since regressions I run on the dataset while I was compiling it were showing promising results. In table 8 I present some of the results from the preliminary dataset. Especially model 1 and 2 in table 8 were promising, the only difference between the data underlying these regressions and the data underlying the regressions found in table 3 and 4 column "All countries" is that there were 16 fewer observation in the dataset used for table 8, the results in Model 3–4 uses the exclusion criteria "> 10,000 Students".

The only dissimilarity between the dataset underlying the regression results found in table 8 and the dataset that are used for the results that are given in section 5.2, is that I have only included the countries that actually have observations on the GDP level in 1983. It is possible to put forward

Table 8: Sensitivity

	Model 1	Model 2	Model 3	Model 4
(Intercept)	6.91^{***}	4.69^{**}	8.41^{***}	5.03^{**}
	(1.62)	(1.67)	(1.65)	(1.79)
log(rgdpl.1983)	-0.49^{**}	-0.61^{***}	-0.62^{***}	-0.73^{***}
	(0.16)	(0.16)	(0.16)	(0.15)
law.share	$-0.03^{\dagger}$	-0.04^{*}	$-0.04^{\dagger}$	-0.03
	(0.02)	(0.02)	(0.02)	(0.02)
engineering.share	0.06^{*}	0.07^{*}	0.04	$0.05^{\dagger}$
	(0.03)	(0.03)	(0.03)	(0.02)
kg		0.01^{*}		0.02^{**}
		(0.00)		(0.01)
ki		0.00		$0.01^{\dagger}$
		(0.00)		(0.00)
Primary.school.enrollment.1983		0.02^{**}		0.02^{*}
		(0.01)		(0.01)
coups		0.37		0.51
		(0.69)		(0.65)
N	87	87	71	71
R^2	0.14	0.27	0.21	0.38
adj. R^2	0.10	0.20	0.18	0.31
Resid. sd	1.81	1.71	1.55	1.42

Standard errors in parentheses

† significant at $p < .10$; $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

arguments for why it is correct to used data from other years to fill in as I have done in section 5.2. The reason why this could be a good idea is that most of the countries that have missing data are regions that later become countries, most of them are in the Eastern bloc. For example Azerbaijan didn't exist as a country in 1983 but it was still a region that was recognised and since data from that period for the countries in question are known to be of questionable quality – it could actually be better to use data from the early 90s than the data recorded by the Soviet Union. Data are recorded by the Soviet Union at the time are widely known to be inflated (Åslund, 2007).

But on the other hand one could also put forward the argument that these countries shouldn't be included since there didn't exist as countries at that time. So by choosing which of these two arguments one wants to follow one could also choose if the regressions become significant or not.

I have therefore tried to test whether or not the true relationship is the one given in table 8 or if this is due to a statistical arbitrariness. I have resampled my dataset 1 million times by drawing 87 observations from the original dataset. I Than run the regression model on the 1 million datasets without testing or controlling for heteroscedasticity. I have summarised the results from this regressions in table 9 and figure 3. To control whether or not the countries with missing GDP where biasing my results, I have also resampled data from the dataset without these countries. I have drawn 69 observations of the 87 observations 1 million times and then run the regressions on these data sets. As can be seen from figure 3e and 3g there is something strange with this data.

This statistical technique that I have deployed here is called jackknifing and is similar to bootstrapping, but where bootstrapping replaces the dropped data with estimates drawn from a statistical distribution based on an estimation of the empirical distribution of the dataset. Jackknifing does not replace the dropped data. The technique was first suggested by Quenouille (1956), where he introduces this technique for reducing biased in a serially correlated estimator. The technique was further developed by Tukey (1958), for a somewhat old review of jackknifing see Miller (1979). The jackknifing procedure also makes the results robust against outliers. For more on bootstrapping see (Horowitz, 2001).

I have only removed 16 out of 103 and 18 out of 87 observations for doing the resampling operation, it can seem like I have dropped too few observations and that I would draw the same dataset several times. If this had been the case this could have biased the results, but this is not the case the combination of datasets that are possible to draw are truly astronomical. The

Table 9: Percentage of significant results

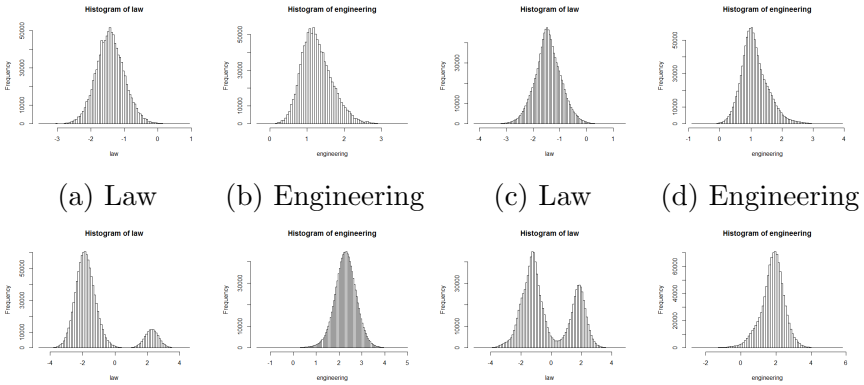
	$p < .10^b$	$p < .05^c$	Mean t-value	Median t-value	s.d.[a] t-value
87 out of 103					
All countries					
law	30.04%	9.36%	−1.42	−1.43	0.43
engineering	17.61%	6.16%	1.26	1.22	0.42
law and engineering	7.63%	1.44%			
> 10,000					
law	32.59%	13.63%	−1.44	−1.45	0.49
engineering	12.01%	4.26%	1.12	1.07	0.44
law and engineering	4.81%	1.14%			
69 out of 87					
All countries					
law	67.46%	46.54%	−1.32	−1.74	1.48
engineering	91.57%	76.43%	2.28	2.28	0.48
law and engineering	61.26%	35.54%			
> 10,000					
law	41.80%	24.09%	−0.23	−0.85	1.62
engineering	64.51%	42.83%	1.80	1.86	0.68
law and engineering	28.28%	12.15%			

[a]Standard deviation
[b](t-value > 1.64)
[c](t-value > 1.96)

probability of drawing the same dataset at least two times is $1/2.245547 \times 10^{12}$ and $1/1.923856 \times 10^{12}$ respectively.[24]

The result from the jackknifing estimations – done on the 87 out of 103 (87/103) datasets – reveals that the findings in the preliminary dataset were due to a statistical anomaly, the case that both engineering and law share turn up as significant at t-value > 1.64 only happens in 7.63% of the re-

[24] $\frac{103!}{87! \cdot 16!} / (1 \times 10^6) = 2.245547 \times 10^{12}$ and $\frac{87!}{69! \cdot 18!} / (1 \times 10^6) = 1.923856 \times 10^{12}$



(a) Law (b) Engineering (c) Law (d) Engineering

(e) Law (f) Engineering (g) Law (h) Engineering

Figure 3: Histograms of the t-values[a,b]

[a]Figure 3a and 3b 87 out of 103 "All countries", figure 3c and 3d 87 out of 103 "Student enrolment > 10,000".

[b]Figure 3e and 3f 69 out of 87 "All countries", figure 3g and 3h 69 out of 87 "Student enrolment > 10,000"

gressions. In table 9 I have summarised my findings, and from this it can be seen that finding and significant a negative effect of the law share turns up relatively often, respectively 30.04% for a t-value > 1.64 and 9.36% for t-value > 1.96. For the (87/103) datasets, neither law nor engineering share is significant with the "wrong" sign i.e., β value of law is always negative and β value of engineering is always positive when significant. The mean t-value for engineering is 1.27 with a standard deviation of 0.42 and for law is -1.41 with a standard deviation of 0.43. This means that significance with a confidence interval of 90% is within the standard deviation for both variables. But as table 9 shows it is quite seldom that the two variables are jointly significant, this only happens in 7.68% and 1.44% for a p-value of 0.1 and 0.05 respectively.

Another interesting observation that can be done from table 9 is that the mean and median are not equal to each other, except for engineering in the 69 out of 87 (69/87) "all countries". This implies that even though I have run

1 million regressions the distribution of the p-values may not follow a normal distribution. For the (69/87) datasets this is definitely the case, as can be seen from figure 3e and 3g which displays a twin peaked distribution. I can only speculate on why the law variable exhibits this strange behaviour, my guess is that either there is an interaction effect which leads the law variable to have different effects in high and low income countries. Or it could be due to some sort of non-linear relationship between the law variable and economic growth.

To check for any interaction effects, I have run the regression with the interaction term law.share^2. The histogram of the t-value for the interaction term showed a multimodal distribution, with the majority the estimates suggesting that are law.share^2 negative.[25] This suggests that the law share effect on growth either stabilises or displays a hump shaped relationship. A hump shape relationship seems plausible, since this will imply that economic growth will suffer in an economy with too few or too many people with a background in business, social science and law.

It would have been very interesting to see if the original data used by Murphy et al. (1991) exhibits the same strange behaviour as I have found here, but as I mentioned above I haven't been able to get hold of the original dataset.

The law variable is a tricky variable to interpret; every country needs bureaucrats with a background in social science, law and business. But if this sector becomes too big this will have negative effects, it could be that highly talented people becomes bureaucrats and this takes this highly talented people of way from the wealth creating sector of the economy. This is essentially the story described by equation 4.5. Or it could be that a big bureaucracy leads to higher level of rent-seeking, if there are not enough checks and balances on the bureaucrats. People with a background in social science, business and law are also essential to a modern economy. As pointed out by

[25]The histogram can be found in appendix C

North (1990) transaction costs tend to increase when an economy becomes more complex and this leads to higher demand of bureaucrats. The results given in figure 3e and 3g shows that in some combination of countries the law variable could have a positive effect on economic growth. This suggests that North's transaction cost story could be an explanation for these results.

Apart from the fact that the results are sensitive to which countries that are included in the analysis, it could also be the case that the result would be sensitive to the source of the economic growth variable. Ciccone and Jarociński (2010) has tested this and finds that which variables that are robust for explaining economic growth depends on the data source of the growth variable. In the article they used data from WDI and the PWT and also different versions of the PWT, their findings is that which variable that are explaining economic growth differs between which dataset are deployed in the regressions. I have not tested my results against other sources for the economic growth variable, so I am not able to say if this is the case here.

6 Conclusion

In this thesis I have demonstrated that rent-seeking can have several effects on wealth-creating entrepreneurs. I have given a presentation of two models that shows different effects, the model by Murphy et al. (1991) highlights the allocation of talent. While the model by Acemoglu (1995) shows that an economy with a high level of rent-seeking will have fewer people that choose to become a wealth creating entrepreneurs since they will not be the full recipient of their effort.

I have further demonstrated that both models can be applied at explaining events in economic history. The Murphy et al. (1991) story can be used to highlight the history of entrepreneurs in Russia since the mid-80s. While the Acemoglu model, can be seen as illuminating some of the causes for the Industrial Revolution.

In the empirical part of the thesis I have demonstrated that the estimation technique used by Murphy at Al fall short of being significant on updated data. Some of my results show signs of significance and suggests a negative correlation between the share of student enrolled in business, social science and law and economic growth. The results cannot be interpreted as causal, and as the section on sensitivity suggests there may be a non-linear relationship between the two variables. Results found by the jackknifing procedure points to a broader problem with cross-country growth regressions, these regressions seem to be very sensitive to small changes in the underlying data. This procedure also demonstrates that it is possible to alter the results by conducting some data mining.

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A Data coverage

Table A.I: Data coverage

Country	school	law and engineering share	g1983
Albania	1983	2000	1983
Algeria	1983	2004	1983
Angola	1983	1999	1983
Argentina	1983	2003	1983
Australia	1983	1998	1983
Austria	1983	1999	1983
Azerbaijan	1981	2008	1992
Bangladesh	1983	2001	1983
Belgium	1983	2000	1983
Bolivia	1983	2000	1983
Brazil	1983	2002	1983
Brunei	1983	1999	1983
Bulgaria	1983	1999	1983
Burkina Faso	1983	2006	1983
Burundi	1983	2002	1983
Cambodia	1983	2001	1983
Cameroon	1983	2004	1983
Canada	1983	1998	1983
Cape Verde	1983	2008	1983
Chile	1983	2002	1983
Colombia	1983	2001	1983
Congo, Republic of	1983	2002	1983
Costa Rica	1983	2004	1983
Cote d'Ivoire	1983	2007	1983
Croatia	1992	1999	1989

Table A.I: (continued)

Country	school	law and engineering share	g1983
Cuba	1983	2006	1983
Cyprus	1983	1999	1983
Czech Republic	1983	1999	1989
Denmark	1983	1999	1983
Djibouti	1983	2001	1983
El Salvador	1983	2002	1983
Eritrea	1988	1999	1991
Estonia	1983	1999	1989
Ethiopia	1983	1999	1983
Finland	1983	1998	1983
France	1983	2006	1983
Georgia	1981	1999	1992
Greece	1983	2002	1983
Guatemala	1983	2002	1983
Guinea	1983	2004	1983
Guyana	1983	2004	1983
Honduras	1983	2003	1983
Hungary	1983	1999	1983
Iceland	1983	1998	1983
Iran (Islamic Republic of)	1983	2004	1983
Iraq	1983	2000	1983
Ireland	1983	1998	1983
Israel	1983	1999	1983
Italy	1983	1999	1983
Japan	1983	1998	1983
Jordan	1983	2003	1983
Kenya	1983	2000	1983

Table A.I: (continued)

Country	school	law and engineering share	g1983
Korea, Republic of	1983	1998	1983
Kyrgyzstan	1981	2001	1992
Laos	1983	2000	1983
Latvia	1983	1999	1992
Lebanon	1983	2000	1983
Lesotho	1983	2005	1983
Liberia	1980	1999	1983
Libya	1983	2000	1985
Lithuania	1981	1999	1992
Luxembourg	1983	2006	1983
Macedonia	1992	1999	1989
Madagascar	1983	2005	1983
Malaysia	1983	2002	1983
Malta	1983	1999	1983
Mexico	1983	1999	1983
Mongolia	1983	1999	1983
Morocco	1983	1999	1983
Mozambique	1983	2004	1983
Namibia	1988	1998	1983
Netherlands	1983	1999	1983
New Zealand	1983	1998	1983
Norway	1983	1998	1983
Oman	1983	2005	1983
Panama	1983	2002	1983
Philippines	1983	2003	1983
Poland	1983	1998	1983
Portugal	1983	2000	1983

Table A.I: (continued)

Country	school	law and engineering share	g1983
Qatar	1983	2001	1985
Romania	1988	1999	1983
Samoa	1983	2000	1983
Saudi Arabia	1979	2000	1985
Sierra Leone	1983	2000	1983
Slovak Republic	1992	1999	1986
Slovenia	1983	1999	1989
Spain	1983	1999	1983
Suriname	1983	2002	1983
Swaziland	1983	1999	1983
Sweden	1983	1999	1983
Switzerland	1983	1999	1983
Tajikistan	1990	2000	1992
Tanzania	1983	1999	1983
Trinidad & Tobago	1983	2000	1983
Tunisia	1983	2003	1983
Turkey	1983	1998	1983
Uganda	1983	1999	1983
Ukraine	1983	1999	1992
United Kingdom	1983	1999	1983
United States of America	1983	2005	1983
Uruguay	1983	2007	1983
Uzbekistan	1981	2006	1989
Venezuela	1983	2008	1983

B Original

Table B.II: Summary statistics for engineering and law majors as percentage of college students

	Full sample		Countries with 10,000 or more students	
	Engineering	Law	Engineering	Law
Mean	10.39	8.89	12.03	7.25
Median	9.08	5.52	10.25	5.61
25th percentile	3.83	2.65	7.26	3.10
75th percentile	14.31	11.20	15.92	10.05

Table B.III: Regressions of growth of growth-read GDP per capita between 1970 and 1985 on proportions of majors in engineering and law (in 1970)

Model	All countries	>10,000 Students
	(1)	(2)
Constant	0.013	0.015
	(0.005)	(0.004)
Engineering	0.054	0.125
	(0.027)	(0.037)
Law	−0.031	−0.065
	(0.025)	(0.049)
GDP 1960	0.000	−0.002
	(0.001)	(0.001)
N	91	55
R^2	0.09	0.23

Table B.IV: Determinants of growth rate of real GDP per capita between 1970 and 1985

Model	All countries	>10,000 Students
	(1)	(2)
Constant	0.018	0.020
	(0.010)	(0.011)
Investment	0.086	0.085
	(0.032)	(0.039)
Primary school enrollment	0.022	0.012
	(0.009)	(0.011)
Government consumption	−0.145	−0.064
	(0.040)	(0.053)
Revolutions and coups	−0.028	−0.035
	(0.009)	(0.009)
GDP 1960	−0.007	−0.006
	(0.001)	(0.001)
Engineering	−0.010	0.054
	(0.023)	(0.034)
Law	−0.024	−0.078
	(0.020)	(0.040)
N	91	55
R^2	0.47	0.56

Table B.V: Regressions of Table B.II independent variables on proportions of majors in engineering and law

Model	All countries	>10,000 Students
	(1)	(2)
A. Estimated auxiliary regressions for engineering		
Investment	0.243	0.432
	(0.081)	(0.119)
Primary schooling	0.904	1.02
	(0.271)	(0.408)
Government consumption	−0.142	−0.181
	(0.056)	(0.078)
Revolutions and coups	−0.090	−0.300
	(0.265)	(0.445)
N	91	55
B. Estimated auxiliary regressions for law		
Investment	−0.093	0.055
	(0.076)	(0.160)
Primary schooling	−0.093	0.576
	(0.254)	(0.548)
Government consumption	0.006	−0.089
	(0.053)	(0.105)
Revolutions and coups	−0.121	0.141
	(0.248)	(0.597)
N	91	55

Table B.VI: Decomposition of the effect of engineering and law majors on growth into direct and indirect effects

Model	All countries	>10,000 Students
	(1)	(2)
A. Estimated effects for engineering		
Investment	0.021	0.037
Primary schooling	0.020	0.012
Government consumption	0.021	0.012
Revolutions and coups	0.002	0.003
Direct	−0.010	0.054
Total	0.054	0.125
B. Estimated effects for law		
Investment	−0.008	0.005
Primary schooling	−0.002	0.007
Government consumption	−0.001	0.006
Revolutions and coups	0.004	−0.005
Direct	−0.024	−0.078
Total	−0.031	−0.065

C Histogram

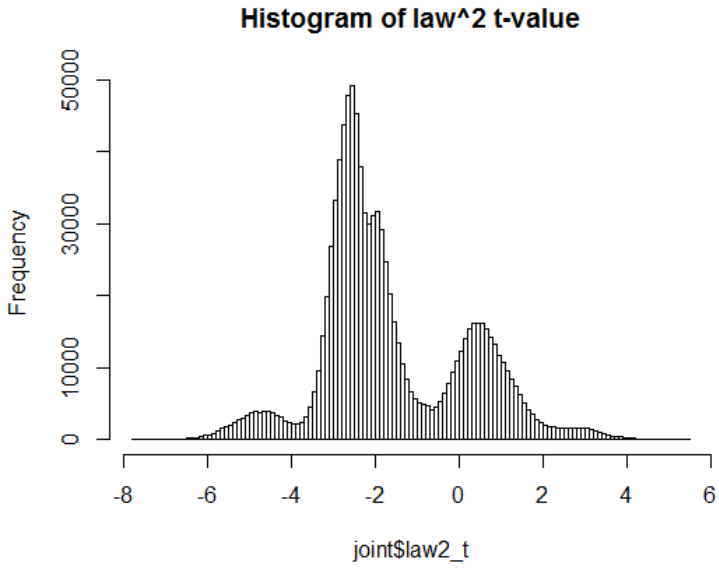

Figure 4: The histogram is based on the 69/87 "Student enrolment $> 10{,}000$" with 1 million drawings.